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THE QUADRUPEDS OF ARIZONA.

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The wild and primitive region which constitutes the Territory of Arizona exhibits a remarkable diversity of surface in its mountain ranges, grassy plains, and desert wastes; and its Fauna and Flora are varied in a corresponding degree. The traveller meets, at each successive day's journey, new and strange objects, which must interest him, if only through the wonder and astonishment they excite. In every department of Natural History there is ample field for observation and study; and even at this late day, opportunities for discoveries in Zoölogy and Botany. First in importance, as they are also in general interest to the observant traveller, are undoubtedly to be ranked the quadrupeds of the country; and so savage and unreclaimed is its condition, that they are there to be seen in what is truly a state of nature. Their habits, and even their numbers have been as yet scarcely subjected to modifying influences by contact with civilization; and he must be stolid indeed, who, under such rarely favorable circumstances, does not look about him

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with interested attention, and learn something of the strange animals by which he is surrounded.

The number of species resident in Arizona is not very great; but nearly all our North American families are represented, and some very fully, which gives to the country its full share of variety in its mammalian forms. At the same time, the individuals of many species occur in multitudes, and constitute marked features of the region in an economic, as well as scientific point of view, from the destructive agency of some, or the value of others as furnishing food and clothing. About seventy species are accredited to the Territory; though this estimate must be regarded as merely approximate, since our most accomplished naturalists are comparatively unfamiliar with the full richness of the Fauna. Of this number, perhaps not more than half are abundant, or from their size, habits, and general importance often brought to the notice of other than professed naturalists. A still larger proportion, though common enough, are very inconspicuous on account of their diminutive size and retiring disposition, and, therefore, are but slightly known. But they should not, on these accounts, be considered less interesting and attractive. The shrew, the mole, the rat, rightly estimated, afford as wide a field for investigation and reflection as the bear, the deer, or the buffalo; and their careful study will as amply repay the naturalist. No single thing in nature is insignificant; nor is there any object incapable of affording both pleasure and instruction to him who will examine with that hearty enthusiasm, and in that true spirit of enlightened inquiry, which should be possessed by one who would call himself a naturalist.

The following pages are prepared mainly from field-notes taken by the writer during his residence in the

Territory. The predominant features of the mammalian Fauna are noticed, and all the species which have fallen under his own observation, or are otherwise known to him as inhabitants of Arizona, are at least alluded to. But the limits of an article like the present necessarily preclude a detailed account of the habits and manners of other than the more characteristic and interesting animals.

Order *Cheiroptera*, the Bats. Of this remarkable and interesting order two groups are represented: one by a single species, the other by numerous forms. The *Istiophora*, or Leaf-nosed Bats, are so called from having a curious membranous expansion of the snout, of a fancied foliaceous appearance, in which the nostrils open. This group is represented by the *Macrotus Californicus*, the Long-eared Bat of California, described and figured by Professor Baird in the Zoölogy of the Mexican Boundary Survey. The type specimen was obtained at Fort Yuma, at the extreme south-west corner of the Territory, and was the first indisputable instance of the occurrence of the group in the United States. I have not met with it personally, and am not aware that any account of its habits has been placed on record.

The other known species of Arizonian Bats belong to the extensive family *Vespertilionidæ*, which is so generally distributed throughout the United States. Perhaps the most interesting species, and one of the commonest, is the Pale Bat (*Antrozous pallidus* Allen), first described by Major Le Conte from California, but now known to range over New Mexico and Arizona. Besides some dental and cranial peculiarities, which separate it generically from *Vespertilio*, its index finger has two phalanges, exhibiting a tendency towards the characters of an en-

tirely different family. This Bat is, as its name indicates, much lighter and paler in color than most of our other species; and it has also a peculiar physiognomy, more repulsive and forbidding than is usual even in this family, none of whose members have remarkably prepossessing features. Its naked muzzle has a peculiar livid hue in life. The species is very abundant at Fort Yuma, where, during the hot months, it becomes a decided nuisance. Numbers take up their abode in the chinks and crannies of the officers' quarters; and the proximity of these retreats actually becomes offensive from the multitudes crowded together. During the daytime a continual scratching and squeaking, as of so many mice, is heard in their retreats, and at night they are even more annoying, by fluttering in scores about the rooms. They are accused of harboring about their bodies quantities of those nocturnal pests, the bed-bugs; but whether justly or not I cannot say. When caught or disabled, they have a harsh squeak; and if incautiously handled, bite with vigor and considerable effect.

The well-known little Brown Bat (*V. subulatus* Say) is generally and abundantly distributed throughout the Territory.

In the Colorado Desert, near Fort Mojave, I procured a small Bat, much like the preceding species; but which my friend Dr. Allen, who kindly examined it, considers as probably a new species, and has named *Vespertilio macropus*.* It chiefly differs from *Vespertilio subulatus* in the degree of the attachment of the wing membrane to the foot. When shot, it was industriously capturing insects over a small pool, in broad daylight.

*In the Proceedings of the Academy of Natural Sciences, Philadelphia, for August, 1866.

Other Arizonian Bats, which I have not personally met with, but give on Dr. Allen's authority, are *Lasiurus cinereus*, *Vespertilio lucifugus*, *V. evotis*, and *V. nitidus*.

Order *Insectivora*, the Insect-eaters. Arizona, so far as is known, is remarkably deficient in small insectivorous mammals, such as the Shrews and Moles. I have never met with a single species, nor am I aware that any have been brought to the notice of naturalists from within the actual limits of the Territory. These animals, however, are very inconspicuous, from their diminutive size, and peculiarly retiring habits; and, therefore, easily escape detection. It is extremely unlikely that none exist; and most probably future investigations will bring to light several species already known from other localities, and some new to science.

Order *Carnivora*, the Flesh-eaters. As might be expected from the unreclaimed condition of the Territory, the native carnivorous animals are still to be found in scarcely diminished numbers. Representatives of all our North American families are furnished, and some of them exist in great abundance.

Of the family *Felidæ*, the Cats, first in size and general consequence, if not in point of numbers, is the Cougar (*Felis concolor* Linn.). With hardly the exception of the Jaguar (*F. onza* Linn.), this is the most powerful of all our digitigrade carnivores. It was formerly distributed quite across the continent, and to high latitudes; but, like most large *Feræ*, it has been gradually driven westward by the progress of civilization, till its occurrence in the East is rare, and only known in the most mountainous and unfrequented regions. Few animals have a greater variety of local names than this one. Its common appellation, "panther," generally becomes "pain-

ter" in the phraseology of backwoodsmen. Its proper English name is probably a modification of "Cuguar," a word which, as suggested by Dr. Schott, may have been formed after the same model as "Jaguar," and bestowed from some fancied resemblance in sound to a common cry of the animal. Another English name is "Puma." The Californians call it "lion," and the Mexicans "leon," and the Apachés "yutin." Though generally distributed, and particularly in the wooded and mountainous portions of the Territory, it is not a very abundant species. During a somewhat protracted residence in the Territory, I never met with one, or heard its peculiarly mournful, though terrifying cry, which has been so fancifully interpreted by different writers. Mr. Audubon doubtless comes nearest the truth, when he ascribes to it a variety of sounds, dependent upon age, sex, season, and other varying circumstances; though nothing to be dignified as a roar has ever been attributed to it. Authors agree better in considering it as a cowardly beast, despite its size and strength; and though there are undoubted instances of unprovoked attacks upon man, these were doubtless made under peculiar exigencies, as when its retreat has been cut off, or the animal was tormented with hunger. That the Indians pursue it successfully with only their bows and arrows I know to be a fact, as I have found skins in their possession cut in various places with the sharp stone points of their arrow-heads.

Two other species of true long-tailed cats may possibly exist, particularly in the south-eastern portions. These are the Ocelot (*F. pardalis* Linn.), and the Jaguar (*F. onza* Linn.). Within the limits of the United States, however, they have as yet only been found in the valley of the Rio Grande of Texas.

A species of Lynx (*L. rufus* var. *maculatus*) is quite abundant. The most obvious external difference between these animals and the true cats is the shortness of the tail; this member being only a few inches in length. They also stand higher for their length, are more heavily built, and have perhaps less of that lithe and supple movement for which the cats proper are so noted; though they are quite as vigorous and muscular. Their ears are often tufted, and one species, at least, has "side-whiskers," formed by the true fur, in addition to the labial bristles which ordinarily receive this name. In dentition they differ in the absence of one upper molar tooth on each side.

Lynxes are very common in the mountainous portions of Arizona. Near Fort Whipple, a small stream is known as "Lynx Creek" from this circumstance; and the animals may often be seen in daylight in that vicinity. A good many are killed by the Indians, who use their beautiful spotted skins for arrow-quivers. A horizontal cut is carried across the buttocks, just under the tail, out of which aperture the animal is withdrawn. The legs are skinned part way down, and the head quite to the eyes and lips. These latter are then sewn up, the legs cut off, or suffered to dangle, the whole hide is dressed softly, and subjected to a lengthwise stretching. After being turned right-side out, it makes an elegant arrow-case, which is slung by a thong, as we would carry a carbine. The Apaché arrows are over three feet in length, and it requires a Lynx's skin, well stretched, to hold them. Besides these quivers, the Indians also make bags and pouches, for a variety of purposes, skinning the animals in the usual way.

In point of numbers, the family *Canidæ*, the Dogs,

stands foremost among the carnivora, though the family is represented by only two species of Wolves, and perhaps as many of Foxes. The word "wolf" is seldom heard in Arizona, even among the whites, who have completely anglicized the Mexican appellations, which are "lobo" for the larger species, and "coyoté" for the smaller. The Spanish for Fox, "zorro," is less frequently used.

Of the many varieties into which the Gray Wolf of America (*Lupus occidentalis* Rich.) runs, I met with but one, the *griseo-albus*, which is perhaps the commonest race throughout the greater portion of the West. The remarkable variations of color, which, though chiefly local, seem to mark races, as they are transmissible from parent to offspring, have caused great confusion among writers, and great uncertainty as to how many species really exist. Wolves may be found from nearly white to pure black, through every gradation of gray, rufous, and dusky; and these diverse colors exist in such varying proportion, and present such an unbroken chain from one extreme to the other, that it seems impossible to consider them as indicating more than remarkable variations to which a single species may be subject, arising from differences in food, climate, and other circumstances.

All the large wolves I saw in Arizona were of the grizzled grayish-white variety. In winter they are very light colored, appearing from a distance almost white; but along the middle of the back, and down the shoulders and flanks, the light color is mixed with slaty or grayish-black. I met with no winter skins showing any brownish or tawny. At this season their pelages were thick and heavy, and a good many of the animals were killed with poison for the sake of the fur, which made very beautiful robes. They were common enough about Fort Whipple,

though shy and wary, and seldom making their appearance by day; and notwithstanding their size and imposing appearance, the part they played was insignificant compared with that of their smaller relatives, the Coyotés.

This latter animal, the Prairie or Barking Wolf (*Canis latrans* Say), is by far the most abundant carnivorous animal in Arizona, as it is also in almost every part of the West. Practically, the Coyoté is a nuisance; theoretically, he compels a certain degree of admiration, viewing his irrepressible positivity of character, and his versatile nature. If his genius has nothing essentially noble or lofty about it, it is undeniable that few animals possess so many, and so various attributes, or act them out with such dogged perseverance. Ever on the alert, and keenly alive to a sense of danger, he yet exhibits the coolest effrontery when his path crosses ours. The main object of his life seems to be the satisfying of a hunger which is always craving; and to this aim all his cunning, impudence, and audacity are mainly directed.

Much has been written concerning the famous polyglot serenades of the Coyoté, by those who have been unwilling listeners; but it is difficult to convey an adequate idea in words, of the noisy confusion. One must have spent an hour or two vainly trying to sleep, before he is in a condition to appreciate the full force of the annoyance. It is a singular fact that the howling of two or three wolves gives an impression that a score are engaged, so many, so long drawn are the notes, and so uninterruptedly are they continued by one individual after another. A short, sharp bark is sounded, followed by several more in quick succession, the time growing faster, and the pitch higher, till they run together into a long-drawn lugubrious howl, in the highest possible key. The same

strain is taken up again and again by different members of the pack, while, from a greater distance, the deep melancholy baying of the more wary lobo breaks in, to add to the discord, till the very leaves of the trees seem quivering to the inharmonious sounds. It is not true, as asserted by some, that the Coyotés howl only just after dark, and at daylight. Though they may be noisiest at these times, when the pack is gathering together for a night's foraging, or dispersing again to their diurnal retreats, I know that they give tongue at any time during the night. They are rarely, if ever, heard in the daytime, though frequently to be seen, at least in secluded regions. Ordinarily, however, they spend the day in quiet, out of the way places, among rocks, in thick copses, etc., and seek their prey mainly by night, collecting for this purpose into packs, as already noticed.

The Coyoté, although a carnivore, is a very indiscriminate feeder, and nothing seems to come amiss, which is capable of being chewed and swallowed. From the nature of the region it inhabits, it is often hard pressed for food, particularly in the winter season. Besides such live game as it can surprise and kill, or overpower by persevering pursuit and force of numbers, it feeds greedily upon all sorts of dead animal matter. To procure this, it resorts in great numbers to the vicinity of settlements, where offal is sure to be found, and surrounds the hunter's camp at night. It is well known to follow for days in the trail of a travelling party, and each morning, just after camp is broken, it rushes in to claim whatever eatable refuse may have been left behind. But it cannot always find a sufficiency of animal food, and is thus made frugivorous and herbivorous. Particularly in the fall, it feeds extensively upon "tunas," which are the juicy, soft, scarlet

fruit of various species of Prickly Pear (*Opuntia*); and in the winter upon berries of various sorts, particularly those of the Juniper (*Juniperus pachyderma*, and others).

Coyotés are so annoying, that a variety of means are employed to destroy them. They may be shot, of course, but to hunt them in the daytime is uncertain, and hardly worth the trouble, while night-shooting is still more laborious and unsatisfactory. Their cunning, inquiring disposition is ordinarily more than a match for man's ingenuity in the way of traps. The most certain, as well as the easiest method of obtaining them, is by poisoning the carcass of a dead animal, or butcher's offal, with strychnine. There is no doubt, also, that the odor of assafœtida is attractive to them, and a little of this drug rubbed into the poisoned meat greatly heightens the chances of their eating it. Since, after taking the poison, they suffer greatly from thirst, it is well to place a tub of water conveniently at hand, which generally keeps them from making off for water, and so being lost. There is considerable difference in the fur, both as to quality and color, according to the season. In the winter it is fuller, thicker, and softer than in summer, and has much less tawny or rufous about it, being almost entirely black and grizzled grayish-white.

Except under certain circumstances, there is a chronic feud between our domestic dogs and these dog-wolves. A good-sized dog will easily whip a Coyoté, though he may not come off unscathed from the sharp teeth and quick snaps of the latter. I have known a smallish terrier even to kill a Coyoté, of which he caught a throat-hold, enabling him by vigorous shakes to beat in the wolf's skull against some boulders between which the conflict took place. Notwithstanding, there is abundant

evidence that the Coyoté will cross and bear fertile offspring with the domestic dog; and I believe the female of either will take the male of the other. During the season of heat, which is in spring, I have known dogs to disappear for several days, and return in such a dilapidated condition as to leave no doubt they had been decoyed away by some female Coyoté, and received hard treatment from her or her relatives. The hybrid is said to possess the bad qualities of both parents, and the good ones of neither, as usual with bastards; and to always remain snappish and intractable, spite of severity or kindness. The gestation of the species, as is well known, does not differ materially from that of its allies. It brings forth in May or June, in secluded places, usually under or among rocks. Five or six puppies are ordinarily produced at a birth. A variety of absurd stories regarding its reproduction pass current, among even the best informed backwoodsmen; many affirming that the pups are born shapeless, inchoate masses, to be afterwards licked into proper shape by the mother.

Among the quite numerous Foxes of North America, but one, the Gray Fox (*Vulpes Virginianus*), is known as an inhabitant of the Territory. Two others, however, the Prairie Fox (*V. macrourus*), and the little Kit or Swift Fox (*V. velox*), may possibly occur. The Gray Fox itself, though generally distributed, does not seem to be abundant. I procured a number of fine skins from the Indians, who use them as articles of dress, for pouches, and a variety of other purposes. I believe they are always skinned in ordinary hunter fashion, by cutting from chin to tail, which latter is left attached, though the greater part of the legs are removed. — *To be continued.*

THE COCKROACH AND ITS ENEMY.

BY G. A. PERKINS, M. D.

THE instinctive habits of insects furnish no small proportion of the interest which attaches to the study of that class of the animal kingdom. The wasps furnish their full share, and the student of nature never tires of investigating the different methods by which they arrive at the same end,—each species following out the law impressed upon it by the Creator with its very being.

The various species of Vespa deposit their eggs in a paper cell, and feed their young, in a larval stage, with insects, which they chew, and partially digest for this purpose. Another genus (*Pompilus*) excavates a hole in the sand in which she deposits numbers of flies, spiders, etc., and with them an egg, and, burying them, leaves the larva to select its own food from these materials. Others, such as *Pelopæus*, the Mud-dauber, places the same materials in curiously constructed cells of clay, and closes them up with the same masonry. Others still, not content with such small game, select the body of one of the larger insects, and deposit in it the germ of their future offspring.

Of this latter class is a beautiful trig little species (*Ampulex Sibirica* Fabr.), very common in Western Africa, and whose polished metallic body, shining like burnished steel, is familiar to all dwellers on that coast. The Ampulex selects the body of the gigantic Cockroach as the receptacle of its egg, and it is not a little amusing to see in what a business-like and determined manner she sets herself to the task of capturing her victim, and serv-

ing her writ of *habeas corpus* upon the doomed roach, full a dozen times her size.

The wasp enters the apartment, and instantly a great commotion takes place among the cockroaches (and their name is legion in the tropics); frantic with fear, they seek a place of greater security, and, in their haste, often rush into the very danger they seek to avoid; for, should the keen eye of the wasp light upon them, the case is a hopeless one. (It is a matter of wonder in what manner the roach should know of the presence of the wasp, and we can only conjecture that its keen perception may distinguish a peculiar sound in the vibrations of the wings of its enemy, as the larger animals are said to in the roaring of the lion.) The wasp flies like a fury at the roach, and a severe struggle takes place; both using legs and wings in the fight, the contest is usually a short one, for the wasp, seizing its victim by the head, or front of the thorax, bends its body short round and plunges its sting into the nearest part, and the roach, who a moment before was fighting for dear life, becomes as quiet as a sleeping infant,—not a leg moves. The victorious wasp draws off a few inches, seeming to survey her vanquished foe with pride, then proceeds to brush off the dust from its brilliant coat and wings, and, after pluming its antennæ, prepares to place its prize in a secluded spot. Taking the roach by the head, she leads him away a few feet, and, leaving him, examines the vicinity for this purpose. In one instance, the cockroach was dragged with considerable trouble between the leaden lining of a tea-chest and the outer box; in another, an open-backed book answered her purpose; but the most singular spot was the inside of a door-lock. The cockroach walked slowly up the door to the key-hole, led by the wasp, and, after

much pulling on the part of the wasp, was forced into the interior. After being out of sight a few minutes, the wasp returned, took several nails from a paper which lay on the floor near by, and carried them, one by one, into the key-hole. I could not but admire the perseverance manifested in this effort. The wasp was obliged to walk backwards up the door to the key-hole; the nail could not be turned by the wasp into a proper position to enter endwise, and, consequently, fell to the floor several times before being successfully drawn in, and each time the wasp descended immediately to renew the attempt. The lock was taken off carefully, and *six four-penny nails* found covering the body of the roach.

Not the least singular feature in the case is, that the sting of the wasp does not kill the cockroach, but only stupefies him, so that the roach, when he walks to his final resting-place, may certainly be said to *go to his own funeral as chief mourner!*

The bodies of this species of cockroach are often found with the empty cocoon of the wasp occupying the cavity of the abdomen; the young wasp, having been hatched there, and, after completing its larval stage, spinning this cocoon, still remains there to complete its development, when it comes forth a perfect insect, in all respects like its parent.

To show with what tenacity the wasp sticks to her prey when once within her grasp, we once put a cockroach, which had been paralyzed, with the wasp, in a glazed earthen pitcher, and watched the result. The wasp attempted to lead the roach out of the pitcher, to which move the cockroach made no objections, and walked up the inclined side of the pitcher as far as his feet would permit him, but not being furnished with the little pads

or suckers with which our common fly and many other insects are provided, he found it out of his power to comply with the requirements of his master, and on attempting to continue his walk, fell to the bottom. The wasp again led him up, and again he fell. This was repeated for the space of three hours, the wasp, in some of her attempts, nearly sustaining the whole weight of the roach. After being convinced of the impossibility of her accomplishing the feat, I liberated the pair, the wasp soon storing her prize away under a bookcase.

FISH CULTURE.

BY CHARLES G. ATKINS.

NEARLY all of our common fishes are *oviparous*, which term, as distinguished from *viviparous*, we may apply to those species of animals which are reproduced by eggs laid in an undeveloped state. In most cases not only are the eggs extruded from the female fish before their development, but also that contact of the male element which impregnates them, and without which no development is possible, is effected after their extrusion.

The operation of spawning, or depositing and impregnating the eggs, as performed by the parent fishes, is essentially as follows. At the spawning season, mature fishes of both sexes repair to a suitable locality; and, having selected a place, the female extrudes her eggs, which sink to the bottom among the pebbles, or, if glutinous, adhere to sticks, weeds, and stones. At the same time, or immediately afterward, the male emits the milt, the fecundating element, which, diffused through the

water, comes in contact with the eggs and impregnates them. In due time, nourished by the water in which they are deposited, and quickened by its heat, they develop and hatch into living fish.

Now a little examination into circumstances will make it evident that a great waste must here occur. A multitude of greedy creatures hover around, ready to devour the eggs as soon as they are left by the parent, or are swept within reach by the current; a portion fails to come in contact with the milt; others are destroyed by noxious sediment or parasitic fungi, or buried deep beneath the shifting sands which the floods may bring down upon them. Should a portion of the eggs escape these dangers, the newly-hatched and defenceless young are eagerly hunted out by all the carnivorous tribes of the water. In the end, comparatively few of the eggs laid result in mature fish; it is perhaps impossible to ascertain the proportion with precision, but one per cent. would be far more than sufficient to maintain and increase the numbers of any species, so enormously fecund are they. Indeed, a rough calculation shows that were one per cent. of the eggs of a salmon to result in full-grown fish, and were they and their progeny to continue to increase in the same ratio, they would in about sixty years amount, in bulk, to many times the size of the earth. Nor is the salmon among the most prolific species. I have counted in a perch (*Perca flavescens*), weighing three and a half ounces, 9,943 eggs; and in a smelt (*Osmerus viridescens*), ten inches in length, 25,141. Some of the larger fishes produce millions at each spawning.

Now if in some way the eggs can be protected from these various dangers that threaten them when abandoned by the parent fish to the ordinary course of nature, it will

at once be seen that a great gain will be made in the number hatched from the spawn of each mother; and if, farther, the young fish can be protected from their enemies until they have acquired size, strength, and agility sufficient to care for themselves, another gain will be thus effected. These two problems are among the most important with which Pisciculture has to deal, but have, we think, been satisfactorily solved.

An interesting experiment was made in Sweden in 1761, by Charles Frederick Lund. He obtained some breams, perch, and mullets, with mature spawn, and placed them in large submerged or floating wooden boxes, in which he had placed quantities of pine boughs. In these boxes the fish were kept several days, until they had completed the process of spawning; they were then removed. The eggs had adhered to the boughs. These species hatch quickly, and in a short time multitudes of young fish emerged from the boughs. In this way he obtained from fifty female breams, 3,100,000 young; from one hundred female perch, 3,215,000 young; and from one hundred female mullets, 4,000,000 young. These are certainly wonderful results. They were placed in the Lake of Ræxen, and dismissed to care for themselves. In a similar way those species, like the trout, whose eggs fall free from each other to the bottom of the stream, may be made to spawn in places where it will be convenient to protect them by enclosures from marauders; and, with a suitable arrangement of small ponds and streams, the young fry of all species may be separated from the old ones that would devour them.

But the crowning discovery in Pisciculture was that of artificial fecundation. This discovery was made during the last century, but was turned to no practical account,

and was hardly practised except in laboratories, when it was re-discovered in France a few years ago, under circumstances that brought its economic bearing prominently before the attention of learned men.

Since the operation of extruding the eggs and milt is essentially mechanical, it can be as well performed by man as by the fish, and, once extruded, the milt performs its own office upon the eggs, and fertilizes them, with no other interference than suffices to bring them into contact. Nay, man can do better than the fish: he can express the eggs into a vessel where none of them will be swept out of reach of the milt, or into the maws of the expectant throng of bystanding fishes; he can then press the milt into the same vessel, and, by stirring them together, insure that the milt shall reach every egg. This is artificial fecundation. But let us examine the method employed.

The operations of Pisciculturists, who have practised artificial impregnation, have been mostly confined to a few species of the family of Salmonidæ. The processes pursued will therefore apply only to a limited extent to the members of other families.

Perhaps salmon and trout have received the most attention. Both these species always seek clear, running, shallow water, and spawn in the autumn or early winter. A female and male, both ripe and ready to spawn, seek a proper place, and on a gravelly bed, swept clean of sand for a small space, the female deposits her eggs, and the male his milt. The operation is described with great minuteness by European writers, but I think that our brook trout (*Salmo fontinalis*) has not been observed sufficiently to ascertain whether its habits are precisely those of the European trout.

All fishes, when spawning, are so intently engaged upon it, that they take very little notice of anything else. Trout can be captured with the greatest ease at this time, —not unfrequently they can be taken with the hand. The following is the artificial process as described by a practical breeder of the brook trout.

The trout, male and female, must be taken with a net, or in some manner that will not injure them, just at the time they are preparing to spawn, and placed in baskets standing in the water in some convenient place. A pan or pail with three or four inches of water in it is brought near the baskets containing the trout. All things being ready, a female trout is taken out of the basket with one hand, and with the other the abdomen is gently rubbed from the gills downward, whereupon the spawn flows in a continuous stream into the vessel. The rubbing is continued until the spawn is wholly extruded, and the trout is then quickly replaced in the water. This operation must not continue more than one minute if possible. On one side of the egg is a small white speck; this is where the impregnation takes place. This side of the egg being lightest, it always falls uppermost. A male trout is now taken, and in like manner the milt is expressed; it falls through the water, and settles upon the eggs. All the trout in the baskets are served in the same manner. The spawn and milt are then placed in shallow vessels, and deposited in water, where they are allowed to remain an hour or more. (Other operators find a few minutes sufficient to insure impregnation, and at the end of that time rinse the eggs thoroughly.)

The manner of proceeding with salmon and other species is essentially the same.

The eggs, being thus artificially impregnated, may be

deposited in a natural stream, under circumstances as closely as possible resembling those chosen by the fish, and left to themselves; or, as is far better, they may be subjected to artificial hatching. By this they may be guarded from various mishaps, the supply of water can be so regulated that it will be uniform, and the eggs can be examined from time to time, and dead and diseased ones be removed before they can injure their neighbors.

It is essential that the incubation be conducted under circumstances like those under which it naturally takes place. The temperature, quality, and state of the water are the main conditions. Some species spawn in fresh water, and some in salt; some in rapid streams, and some in lakes and ponds; some in winter, and some in summer. The temperature required by trout is about forty-one degrees Fahrenheit, ranging, however, from several degrees below this, to about fifty degrees; while some species of summer-spawning fish require a temperature higher than sixty degrees. The time required for development varies with different species, and is much affected by temperature. Some species hatch in five days, while the trout is rarely less than fifty days, and at thirty-seven degrees of heat requires one hundred and thirty-six days.

The apparatus employed in artificial incubation is of various kinds. A metal box, with many holes to admit a free circulation of water, was one of the first employed; this is immersed in the water. Troughs of stone, vessels of earthenware, willow baskets, and wooden boxes have all been used with success in the incubation of salmon and trout.

A favorite form of hatching-box for trout is a long wooden trough, its bottom inclined sufficiently to cause a

gentle flow of water through it, and covered with a layer of gravel; the whole covered in by a lid. The eggs are deposited in the gravel or sand, and a stream of water, an inch or two deep, led through the trough.

At the French Piscicultural establishment at Huningue, and at the Stormontfield salmon-breeding ponds, the hatching apparatus consists of a series of horizontal troughs, arranged side by side like the steps of a stairway, through which a stream of water falls in succession from the uppermost.

After the eggs are deposited in the hatching-boxes, a proper supply of pure water must be kept up until they hatch. They must be frequently examined to remove diseased eggs, and guard against the collection of sediment. It is better that they be kept in darkness, for light encourages the growth of a parasitic fungus.

When trout hatch they have still a large portion of the egg attached to the abdomen; this is gradually absorbed, and while it remains they require no food. It is the "yolk-sack." Upon its complete absorption the young trout begins to feed, and must be placed where he can find his own food, or must be regularly supplied with such as is adapted to his infantile condition, and will attract his attention, and tempt his appetite.

The whole process of producing fish, by artificial impregnation and incubation, is in practice remarkably successful. More than ninety per cent. of the eggs become living fish. Mr. Ainsworth, the authority quoted above, has this year obtained twenty thousand trout from twenty-one thousand eggs, being more than ninety-five per cent.

In another point of view this process is of vast importance. It facilitates the transportation of species from one water to another. Salmon eggs, fecundated, were carried

from Scotland to Australia, in 1865; were successfully hatched in the River Plenty; and, having returned from their first migration to the sea, may now be considered as established there. In a similar manner the Merrimac River has been sown with salmon-eggs brought from New Brunswick, and a harvest may be expected therefrom.

The rearing of fish in artificial ponds and reservoirs, and then bringing them into marketable and eatable condition by regular and systematic feeding, has been successfully carried out, and it is found to be quite practicable as an industrial occupation, bringing better returns, when trout are reared, than the growing of any other kind of animal food. Yet to determine with certainty what are the conditions of success in this branch of Pisciculture requires further experiment.

Pisciculture is not a new art. It was practised among the ancient Romans; yet not as an industrial pursuit, but as a source of amusement to men of wealth and leisure, or to supply with delicacies the tables of a gluttonous nobility. In Catholic countries, since the establishment of monasteries, fish preserves have been commonly attached to those institutions, to supply the devotees with food during their frequent religious fasts. There is no reason, however, to suppose that they had any knowledge of artificial impregnation. In China, it has long been an important branch of industry, and although we know very little of the process that they employ, it is certain that they succeed in making fish an abundant and cheap article of food.

Since the awakening of the public mind to this subject in Europe, government establishments have been put in operation in France and Germany, and private operations of great importance have been carried on in the

British Isles. It is thought that primitive abundance may be restored to their now exhausted rivers, and not many years hence an acre of water shall be made to produce as much food for man as an acre of land. In America many persons have engaged in pisciculture as an experiment, and some attempts have been made to carry it farther; but as nothing has been done on a large scale, no great results have yet been attained.

THE DRAGON-FLY.

PLATE 9.

BY A. S. PACKARD, JR., M. D.

WERE we to select from among the insects a type of all that is savage, relentless, and bloodthirsty, the Dragon-fly would be our choice. From the moment of its birth until its death, usually a twelve-month, it riots in bloodshed and carnage. Living beneath the waters perhaps eleven months of its life, in the larva and pupa states, it is literally a walking pitfall for luckless aquatic insects; but when transformed into a fly, ever on the wing in pursuit of its prey, it throws off all concealment, and reveals the more unblushingly its rapacious character.

Not only does its horrid visage and ferocious bearing frighten children, who call it the "Devil's Darning-needle," but it even distresses older persons, so that its name has become a byword. Could we understand the language of insects, what tales of horror would be revealed! What traditions, sagas, fables, and myths must adorn the annals of animal life regarding this Dragon among insects!

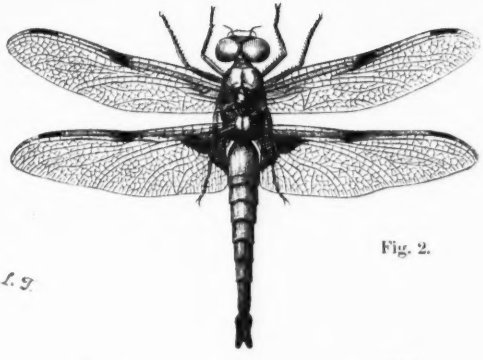

Fig. 2.

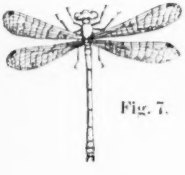

Fig. 7.

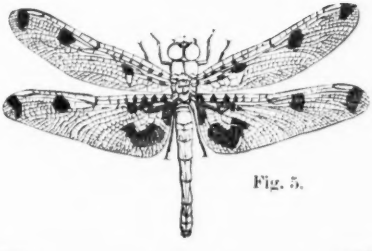

Fig. 5.

Fig. 6.

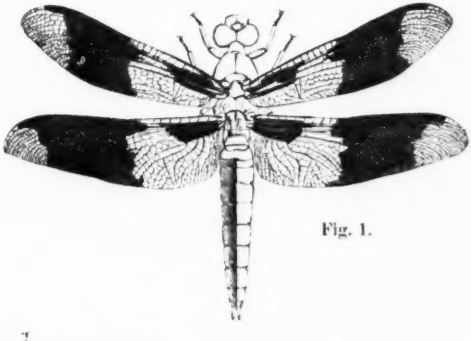

Fig. 1.

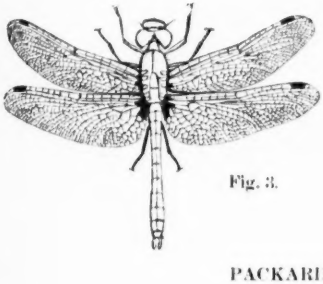

Fig. 3.

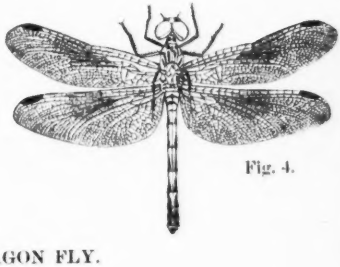

Fig. 4.

PACKARD ON THE DRAGON FLY.

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To man, however, aside from its bad name and its repulsive aspect, which its gay trappings do not conceal, its whole life is beneficent. It is a scavenger, being like that class ugly and repulsive, and holding literally, among insects, the lowest rank in society. In the water, it preys upon young musquitoes and the larvæ of other noxious insects. It thus aids in maintaining the balance of life, and cleanses the swamps of miasmata, thus purifying the air we breathe. During its existence of three or four weeks above the waters, its whole life is a continued good to man. It hawks over pools and fields and through gardens, decimating swarms of musquitoes, flies, gnats, and other baneful insects. It is a true Malthus' delight, and, following that sanguinary philosopher, we may believe that our Dragon-fly is an entomological Tamerlane or Napoleon sent into the world by a kind Providence to prevent too close a jostling among the myriads of insect life.

We will, then, conquer our repugnance to its ugly looks and savage mien, and contemplate the hideous monstrosity,—as it is useless to deny that it combines the graces of the Hunchback of Notre Dame and Dickens' Quilp, with certain features of its own,—for the good it does in Nature.

Even among insects, a class replete with forms the very incarnation of ugliness and the perfection of all that is hideous in nature, our Dragon-fly is most conspicuous. Look at its enormous head, with its beetling brows, retreating face, and heavy under jaws,—all eyes and teeth,—and hung so loosely on its short, weak neck, sunk beneath its enormous hunchback,—for it is wofully round-shouldered,—while its long thin legs, shrunken as if from disease, are drawn up beneath its breast, since our fiend of the air is a poor pedestrian.

Its gleaming wings are, however, beautiful objects. They form a broad expanse of delicate parchment-like membrane drawn over an intricate network of veins. Though the body is bulky, it is yet light, and easily sustained by the wings. The long tail undoubtedly acts as a rudder to steady its flight.

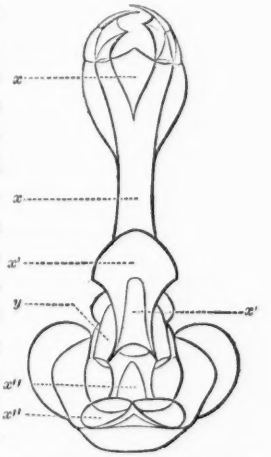
These insects are almost universally dressed in the gayest colors. The body is variously banded with rich shades of blue, green, and yellow, and the wings give off the most beautiful iridescent and metallic reflections.

During this month, the various species of Libellula and its allies most abound. The eggs are attached loosely in bunches to the stems of rushes and other water-plants. In laying them, the Dragon-fly, according to Mr. P. R. Uhler's observations, "alights upon water-plants, and, pushing the end of her body below the surface of the water, glues a bunch of eggs to the submerged stem or leaf. *Libellula auripennis*, I have often seen laying eggs, and I think I was not deceived in my observation that she dropped a bunch of eggs into the open ditch while balancing herself just a little way above the surface of the water. I have, also, seen her settled upon the reeds in brackish water with her abdomen submerged in part, and there attaching a cluster of eggs. I feel pretty sure that *L. auripennis* does not always deposit the whole of her eggs at one time, as I have seen her attach a cluster of not more than a dozen small yellow eggs. There must be more than one hundred eggs in one of the large bunches. The eggs of some of the Agrions are bright apple-green, but I cannot be sure that I have ever seen them in the very act of oviposition. They have curious habits of settling upon leaves and grass growing in the water, and often allow their abdomens to fall below the surface of the

water; sometimes they fly against the surface, but I never saw what I could assert to be the projecting of the eggs from the body upon plants or into the water. The English entomologists assert that the female Agrion goes below the surface to a depth of several inches to deposit eggs upon the submerged stems of plants." The Agrions, however, according to Lucaze Duthiers, a French anatomist, make, with the ovipositor, a little notch in the plant upon which they lay their eggs.

These eggs soon hatch, probably during the heat of summer. The larva is very active in its habits, being provided with six legs, attached to the thorax, on the back of which are the little wing-pads, or rudimentary wings. The large head is provided with enormous eyes, while a pair of simple, minute eyelets (*ocelli*) are placed near the origin of the small bristle-like feelers, or antennæ. Seen from beneath, instead of the formidable array of jaws and accessory organs commonly observed in most carnivorous larvæ, we see nothing but a broad, smooth mask covering the lower part of the face; as if from sheer modesty our young Dragon-fly was endeavoring to conceal a gape. But wait a moment. Some unwary insect comes within striking distance. The battery of jaws is unmasked, and opens upon the victim. This mask (Fig. 1) is peculiar to the young, or larva and pupa

Fig. 1.



Under side of head of *Diplax*, with the labium or mask fully extended. x, x', x'', the three subdivisions of the labium. y, the maxillæ, or second pair of jaws.

of the Dragon-fly. It is the labium, or under lip greatly enlarged, and armed at the broad spoon-shaped extremity (Fig. 1, *x*) with two sharp hooks, adapted for seizing and retaining its prey. At rest, the terminal half is so bent up as to conceal the face, and thus the creature crawls about, to all appearance, the most innocent and lamb-like of insects.

Not only does the immature Dragon-fly walk over the bottom of the pool or stream it inhabits, but it can also leap for a considerable distance, and by a most curious contrivance. By a syringe-like apparatus lodged in the end of the body, it discharges a stream of water for a distance of two or three inches behind it, thus propelling the insect forwards. This apparatus combines the functions of locomotion and respiration. There are, as usual, two breathing pores (*stigmata*) on each side of the thorax. But the process of breathing seems to be mostly carried on in the tail. The tracheæ are here collected in a large mass, sending their branches into folds of membrane lining the end of the alimentary canal, and which act like a piston to force out the water. The entrance to the canal is protected by three to five triangular horny valves (Fig. 2, 9, 10, 2 *a*, side view, 2 *b*), which open and shut at will. When open, the water flows in, bathing the internal gill-like organs, which extract the air from the water. This is then suddenly expelled by a strong muscular effort.

Fig. 2.

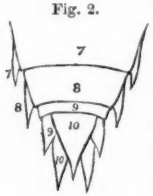


Fig. 2 *a*.

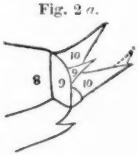


Fig. 2 *b*.

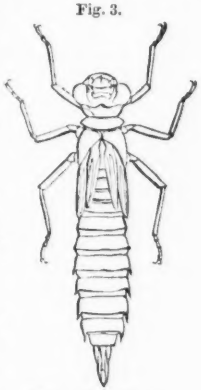
In the smaller genera, *Agrion* (*A. saucium*, Plate 9, fig.

7. Fig. 2 *b*, side view of false-gill, showing but one leaf), *Lestes* and *Calopteryx*, the respiratory leaves, called the tracheary, or false-gills, are not enclosed within the body, but form three broad leaves, permeated by tracheæ, or air-vessels. They are not true gills, however, as the blood is not aerated in them. They only absorb air to supply the tracheæ, which aerate the blood only within the general cavity of the body. These false-gills also act as a rudder to aid the insect in swimming.

It is easy to watch the Dragon-flies through their transformations, as they can easily be kept in aquaria. Little, almost nothing, is known regarding their habits, and any one who can spend the necessary time and patience in rearing them, so as to trace up the different stages from the larva to the adult fly, and describe and figure them accurately, will do good service to science.

Mr. Uhler states that at present we know but little of the young stages of our species, but "the larva and pupa of the *Libellulidæ* may be always known from the *Æschnidæ* by the shorter, deeper, and more robust form, and generally by their thick clothing of hair."

Fig. 3.



Pupa of Æschna.

The pupa scarcely differs from the larva, except in having larger wing-pads (Fig. 3). It is still active, and as much of a gourmand as ever. When the insect is about to assume the pupa state, it moults its skin. The body having outgrown the larva skin, by a strong muscular effort a rent opens along the back of the thorax, and the insect, having fastened its claws into some object at the bottom of the

pool, the pupa gradually works its way out of the larva-skin. It is now considerably larger than before. Immediately after this tedious operation, its body is soft, but the crust soon hardens. This change, with most species, probably occurs early in summer.

When about to change into the adult fly, the pupa climbs up some plant near the surface of the water. Again its back yawns wide open, and from the rent our Dragon-fly slowly emerges. For an hour or more, it remains torpid and listless, with its flabby, soft wings remaining motionless. The fluids leave the surface, the crust hardens and dries, rich and varied tints appear, and our Dragon-fly rises into its new world of light and sunshine a gorgeous, but repulsive being. Tennyson thus describes these changes in "The Two Voices":—

> To-day I saw the Dragon-fly
> Come from the wells where he did lie.
> An inner impulse rent the veil
> Of his old husk: from head to tail
> Came out clear plates of sapphire mail.
>
> He dried his wings; like gauze they grew;
> Through crofts and pastures wet with dew
> A living flash of light he flew.

Of our more common, typical forms of Dragon-flies, we figure a few, commonly observed during the summer. *Libellula trimaculata* of Count De Geer, a Swedish entomologist, of which Fig. 1, Plate 9, represents the male, is so-called from the three dark clouds on the wings of the female. But the opposite sex differs in having a dark patch at the front edge of the wings, and a single broad cloud just beyond the middle of the wing.

Libellula quadrimaculata (Fig. 2, Plate 9), the four-spotted Dragon-fly, is seen on the wing in June, flying through dry pine woods.

The largest of our Dragon-flies are the "Devil's Darning-

needles," *Æschna heros* and *grandis*, seen hawking about our gardens till dusk. They frequently enter houses, carrying dismay and terror among the children. The hind-body is long and cylindrical, and gaily colored with bright green and bluish bands and spots.

Mr. Uhler informs us that the pupa of *Æschna*, figured above, from a drawing by Mr. F. G. Sanborn, is perhaps that of *Æschna constricta*, or *Æ. clepsydra*.

One of our most common Dragon-flies is *Diplax rubicundula*, the ruby Dragon-fly, which is yellowish red. It is seen everywhere flying over pools, and also frequents dry sunny woods and glades. Another common form is *Diplax Berenice* of Drury (Plate 9, Fig. 3 male, Fig. 4 female. The accompanying cut represents the pupa, probably of this species, according to Mr. Uhler.) It is black, the head blue in front, spotted with yellow, while the thorax and abdomen is striped with yellow. There are fewer stripes on the body of the male, which has only four large yellow spots on each side of the abdomen. Still another pretty species is *Diplax Elisa* of Dr. Hagen (Plate 9, Fig. 5). It is black, with the head yellowish and with greenish yellow spots on the sides of the thorax and base of the abdomen. There are three dusky spots on the front edge of each wing, and a large cloud at the base of the hind pair toward the hind angles of the wing.

Fig. 4.

Pupa of *Diplax*.

Rather a rare form, and of much smaller stature is the *Nannophya bella* of Uhler (Fig. 6, female). It was first detected in Baltimore, and we afterwards found it not unfrequently by a pond in Maine. Its abdomen is unusually short, and the reticulations of the wings are large and simple. The female is black, while the male is frosted over with a whitish powder. Many more species

of this family are found in this country, and for descriptions of them we would refer the reader to Dr. Hagen's Synopsis of the Neuroptera of North America, published by the Smithsonian Institution.

The Libellulidæ, or family of Dragon-flies, and the Ephemeridæ, or May-flies, one of which is figured in our second number, are the most characteristic of the Neuroptera, or veiny-winged insects. This group is a most interesting one to the systematist, as it is composed of so many heterogeneous forms which it is almost impossible to classify in our rigid and at present necessarily artificial systems. We divide them into families and sub-families, genera and sub-genera, species and varieties, but there is an endless shifting of characters in these groups. The different groups would seem well limited after studying certain forms, when to the systematist's sorrow here comes a creature, perhaps mimicking an ant, or aphis, or other sort of bug, or even a butterfly, and for which they would be readily mistaken by the uninitiated. Bibliographers have gone mad over books that could not be classified. Imagine the despair of an insect-hunter and entomophile, as he sits down to his box of dried neuroptera. He seeks for a true neuropter in the white ant before him, but its very form and habits summons up a swarm of true ants; and then the little wingless book-louse (*Atropos*) scampering irreverently over the musty pages of his *Systema Naturæ*, reminds him of that closest friend of man—*Pediculus vestimenti*. Again, his studies lead him to that gorgeous inhabitant of the Mediterranean shores, the butterfly-like *Ascalaphus*, with its gorgeous wings, and slender, knobbed antennæ so much like those of butterflies, and visions of these beautiful insects fill his mind's eye; or sundry dun-colored caddis flies, modest,

delicate neuroptera, with finely fringed wings and slender feelers, create doubts as to whether they are not really allies of the clothes moth, so close is the resemblance.

Thus the student is constantly led astray by the wanton freaks Nature plays, and becomes sceptical as regards the truth of a natural system, though there is one to be discovered; and at last disgusted with the stiff and arbitrary systems of our books,—a disgust we confess most wholesome, if it only lead him into a closer communion with nature. The sooner one leaves those maternal apron-strings,—books,—and learns to identify himself with nature, and thus goes out of himself to affiliate with the spirit of the scene or object before him,—or, in other words, cultivates habits of the closest observation and most patient reflection,—be he painter or poet, philosopher or an insect-hunter of low degree, he will gain an intellectual strength and power of interpreting nature, that is the gift of true genius.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 188.)

THE snails thus far described represent a natural group having, generally, a stout, heavy shell, and usually a reflected lip to the aperture. The jaw is heavily ribbed, and the teeth are short, and, on the extreme border of the membrane, serrated. The jaw and teeth of *Helix albolabris*, figured in the first number of the NATURALIST, represents well like characters of the group. The species now to be considered have smooth or polished shells, the

lip simple or sharp, and the teeth are claw-shaped; the jaw being devoid of ribs, having, however, a central projection, as shown in Fig. 19,—(jaw of *Helix inornata*.)

Fig. 19.

Fig 20.

VITRINA LIMPIDA *Gould*. (Fig. 20.) Shell globular, very thin and fragile, transparent and shining. Whorls two to three, the last, or body whorl, very large and expanded; no umbilicus; diameter nearly one-fourth of an inch. Animal greyish, or nearly black, and large compared to the size of the shell. The mantle extends from the aperture of the shell covering the back of the animal to the base of the tentacles, a portion extending backward covering the spire. The animal is always very moist, and appears covered with water.

This species is probably carnivorous in its habits, as in confinement it has been noticed to feed on dead and even live earth-worms, while vegetable food has been rejected. It has been found in northern Vermont, in northern Maine, and near Portland, Me., quite abundant. Outside of the limits of New England this species occurs in the North-western Territory, and the northern parts of the United States bordering on Canada. It is generally found in open ground or low underbrush in damp places.

Figs. 21, 22.

HELIX INORNATA *Say*. (Figs. 21, 22.) Shell depressed, yellowish horn-color, smooth and shining. Whorls five; lip simple and sharp, the lower part reaching to the umbilicus, which is small. Within the lip there is a thick, white shelly deposit which tends to strengthen the fragile aperture. Diameter of shell less than three-fourths of an inch. Animal bluish black, disk whitish. At the termination of the tail there is a gland from which the mucus pours freely when the animal is in motion.

This shell is recorded as being found in Vermont by Professor Adams, though it cannot properly be regarded as a New England species. It is common at the West.

HELIX FULIGINOSIS *Binney*. (Figs. 23, 24.) Shell thin, flattened above, nearly chestnut-color, sometimes a greenish horn-color. Whorls four and a half; last whorl very large, suture slightly indicated. Aperture large, nearly circular, within pearly. Lip simple, brittle, slightly thickened within by a testaceous deposit. Umbilicus not large. Diameter an inch or more. Animal blackish, or bluish black. On the tail there is a slit from which the mucus pours freely. This shell resembles somewhat that of *Helix inornata*, but differs in being much larger, and always having one whorl less. The umbilicus is larger, and the aperture is more circular.

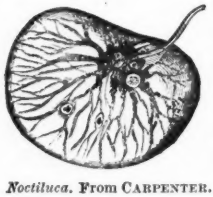
Figs. 23, 24.

This species occurs in nearly all the States east of the Rocky Mountains. It is extremely rare in New England, having been found only in the extreme western limits.

Of the species thus far described in these papers, only three of them can be considered as really common in New England, namely, *Helix albolabris*, *monodon*, and *alternata*. The others are rarely to be met with. It is difficult for the collector to obtain more than ten or twelve specimens of the larger species in a day's ramble, though at the West they may be found by hundreds. The cause of this disparity in numbers is attributed to the abundance of lime-rock at the West; this rock favoring the multiplication of shell-bearing mollusks, while in New England, granitic formations prevail, and the soil from such rocks retards the increase of these animals. — *To be continued.*

THE PHOSPHORESCENCE OF THE SEA.

THE *Noctilucæ* are little crystal balls of about the size of a pin's head, which, under the microscope, present the appearance here figured. The transparence of its structure permits an easy investigation. Not a fibre is to be seen, unless, with De Blainville, we consider the transverse markings of the tail in the light of muscular fibres, a supposition which is very questionable. In the neighborhood of this tail there is usually a mass of food, or the indigestible remains of food. Not that we are to look for a stomach in this animal,—nothing of the kind exists; but in lieu thereof we find, as in Infusoria, a number of *vacuolæ*, or assimilating cavities, which appear and disappear, according to need, formed out of the contractile substance which is seen radiating in filaments all through the substance of the animal, and which M. Quatrefages likens to the *sarcode* described by Dujardin. In this curious animal, not a trace has been discovered of vessels, nerves, senses, or indeed of any "organs" whatever. It is a mass of animated jelly, with a mobile tail. Its mode of reproduction has been variously expounded, but the observations of Quatrefages and Krohn seem placed beyond a doubt by those recorded in Mr. Brightwell's paper, proving that they multiply by spontaneous subdivision. No one has yet observed anything like reproduction by means of ova.



Noctiluca. From CARPENTER.

To these *Noctilucæ* the sea owes much of that brilliant phosphorescence which at all times has been the marvel of

travellers. Place your vase in a darkened room, and strike the glass, or agitate the water, and you will be delighted with the spectacle presented. From every part brilliant sparks appear and disappear, until at length no agitation of the water will produce more; their power is exhausted, as that of the electric eel is exhausted, after a few shocks. You want to know the cause of this phosphorescence? Unhappily the point is still *sub judice*. It is only since the beginning of this century that the attention of naturalists has been fixed upon the *Noctilucæ* as sources of the phosphorescence, in all times observed, and in former times attributed to the presence of decaying organic substance, to electricity, to "an absorption of solar light disengaged in the dark." The investigations of M. Quatrefages led him to the following conclusions:

There are two different kinds of phosphorescence observed in the sea. The first is of very brilliant but isolated sparks, and is due principally to Starfishes, Crustaceans, and Annelids. The second is of a general luminous tint, over which are strewed isolated sparks, and is due to the Noctilucæ. These Noctilucæ have no special organ which produces the phosphorescence, as the other animals have; but the light emanates from the whole substance of their bodies. Every irritant, no matter of what nature, produces this phosphorescence in them. The phenomenon is not, as in insects, one of combustion; but is intimately connected with the contraction, spontaneous or provoked, of their substance. It is independent of all secretion, and it is probable that the sparks are due to the rupture and sudden contraction of their sarcodic filaments; while the steady light they emit in dying, results from the permanent contraction of this sarcodic substance. — *From Lewes' Sea-side Studies.*

REVIEWS.

ORNITHOLOGY AND OÖLOGY OF NEW ENGLAND. By *Edward A. Samuels.* Boston. Nichols & Noyes. 1867. 8vo. Illustrated.

We welcome this work as one long needed, and trust that it will prove the forerunner of a large series of similar ones in the various departments of Natural History. The demand for books on this and kindred subjects is now quite large, and fast increasing, and we only regret that the price of the present volume may put it above the reach of the large number of persons who would advantageously peruse its pages, if within their means. May we not hope that the enterprising publishers of the work, who deserve great praise for their present undertaking, will issue a cheaper edition, that it may become accessible to all?

The volume is gotten up in fine style, and no expense has been spared on the typography and paper. The four plates containing the illustrations of the eggs* are perfect gems of the art of wood-cutting in this country, and show to what perfection it can be carried. It is greatly to be regretted that the fifty or sixty illustrations of birds were not executed for the work with the same care, for they only serve to mar the beauty of the book, and are, with few exceptions, of very little value to the reader.

The character of the work is such as to instruct and interest; the scientific details and matters of classification are well arranged, and copied from the best authors, for which full credit is given. In fact, the author has, so far as we can judge, been honest with all his quotations and clippings from others, and in writing such a work originality in all its details would be almost an impossibility, and in the present state of ornithology wholly uncalled for. That part relating to the habits and nesting of our birds contains much of original observation and research. The practical bearing of many of the observations of the author renders them of great value to the farmer and fruit-grower, and will serve to remove many prejudices that have arisen regarding the comparative benefit and injury derived from the feathered inhabitants of our gardens and woods. Thus, while the

* These four plates contain representations of the eggs of the following birds: — Pigeon Hawk, Sparrow Hawk, Red-shouldered Hawk, Broad-winged Hawk, Great-crested Fly-catcher, Blue Yellow-backed Warbler, Water Thrush, Black-throated Green Warbler, White-bellied Nuthatch, Red-bellied Nuthatch, White-throated Sparrow, Snow-bird, Tree Sparrow, Rose-breasted Grosbeak, Orchard Oriole, Rusty Blackbird, Canada Grouse, Killdeer Plover, Semipalmated Plover, American Woodcock, Wilson's Snipe, Upland Plover, Virginia Rail, Carolina Rail, Herring Gull, Laughing Gull, Kittiwake Gull, Wilson's Tern, Least Tern.

author's account of the habits of the "Poor Crow" may be the cause of many being destroyed at certain seasons of the year, his account of the food of the Robin will undoubtedly be the saving of the lives of thousands of these, by some, most loved, and by others, most persecuted of birds. We extract the following from the account of the habits of the Robin: —

Perhaps none of our birds are more unpopular with horticulturists than this; and I will here give the observations of different scientific men, and my own, to show that the prejudice against the bird is unjust and unfounded. Mr. Trouvelot, of Medford, Mass., who is engaged in rearing silkworms, for the production of silk, is troubled by the Robin to a degree surpassing most other birds. He has a tract of about seven or eight acres enclosed, and mostly covered with netting. He is obliged, in self-defence, to kill the birds which penetrate into the enclosure and destroy the worms. Through the season, probably ten robins, for one of all others, thus molest him; and, of scores of these birds which he has opened and examined, none had any fruit or berries in their stomachs, — nothing but insects. It is to be understood that this was not in a part of the summer when berries were unripe; on the contrary, it was all through the season. His land is surrounded with scrub-oaks and huckleberry-bushes. These latter were loaded with fruit, which was easier of access to the birds than the worms; but none was found in them. He says they came from all quarters to destroy his silkworms, and gave him more trouble than all the other birds together. He said that, in his opinion, if the birds were all killed off, vegetation would be entirely destroyed. To test the destructiveness of these marauders, as he regarded them, he placed on a small scrub-oak near his door two thousand of his silkworms. (These, let me say, resemble, when small, the young caterpillar of the apple-tree moth.) In a very few days they were all eaten by Cat-birds and Robins, — birds closely allied, and of the same habits. This was in the berry season, when an abundance of this kind of food was easily accessible; but they preferred his worms. Why? Because the young of these, as well as those of most other birds, *must* be fed on animal food. Earthworms assist in the regimen; but how often can birds like the Robin, Cat-bird, Thrush, etc., get these? Any farmer knows, that, when the surface of the ground is dry, they go to the subsoil, out of the reach of birds; and it is not necessary here to say what proportion of the time the ground is very dry through the summer. Caterpillars, grubs of various kinds, and insects, therefore constitute the chief food of these birds; and of these, caterpillars and grubs being the most abundant, and most easily caught, furnish, of course, the larger proportion.

In fact, the Thrushes seem designed by nature to rid the surface of the soil of noxious insects not often pursued by most other birds. The warblers capture the insects that prey on the foliage of the trees; the flycatchers seize these insects as they fly from the trees; the swallows capture those which have escaped all these; the woodpeckers destroy them when in the larva state in the wood; the wrens, nuthatches, titmice, and creepers eat the eggs and young that live on and beneath the bark; but the thrushes subsist on those that destroy the vegetation on the surface of the earth. They destroy nearly all kinds of grubs, caterpillars, and worms that live upon the greensward and cultivated soil, and large quantities of crickets and grasshoppers before they have become perfect insects. The grubs of locusts, of harvest-flies, and of beetles, which are turned up by the plough or the hoe, and their pupæ when emerging from the soil; apple-worms, when they leave the fruit and crawl about in quest of new shelter; and those subterranean caterpillars, the cutworms, that come out of the earth to take their food, — all these, and many others, are eagerly devoured by the Robin and other Thrushes. The cutworms emerge from the soil during the night to seek for food; and the Robin, which is one of the earliest birds to go abroad in the morning, is very diligent at the dawn of day in hunting for these vermin before they have gone back into their retreat. The number of these destructive grubs is immense. "Whole cornfields," says Dr. Harris, "are sometimes laid waste by them. Cabbage-plants, till they are grown to a considerable size, are very apt to be cut off and

destroyed by them. Potato-vines, beans, beets, and various other culinary plants, suffer in the same way." The services of the robins, in destroying these alone, would more than pay for all the fruit they devour. Indeed, during the breeding season, a robin is seldom seen without having in his mouth one of these caterpillars, or some similar grub, which he designs for his young; and as the Robin often raises three broods of young during the season, his species must destroy more of this class of noxious insects than almost all other birds together. In my own gardening experiences, I have had my full share of cutworms; and I have always noticed the Robin, Brown Thrush, and Cat-bird busy early in the morning, — almost before other birds are out of their feather-beds, figuratively speaking, — catching these vermin and eating them, or carrying them for food to their young.

THE CRETACEOUS FORMATION OF THE ENVIRONS OF SIOUX CITY, OF THE MISSION OF OMAHAS AND OF TEKAMA, ON THE BORDERS OF MISSOURI. By *Jules Marcou*. From the Bulletin of the Geological Society of France. 1866. 8vo, pp. 15. With a plate.

In this and a previous paper,* the author shows that there is a remarkable discrepancy between the usually accepted laws of the geological succession of animals and plants, and the natural sequence of the rocks containing them. The facts are thus stated in the present article: —

Between Omaha City, Nebraska, and Sioux City, is a fresh-water formation containing a flora entirely composed of genera, which, in Europe, have appeared only at the epoch of the Miocene (middle) Tertiary Period, but which in America, however, is found in the middle of the Cretaceous Period, at the base of the chalk formation.

The steps that led to this discovery are detailed quite fully by Prof. F. V. Hayden, in the American Journal of Science for March, 1867.

LEPIDOPTEROLOGICAL NOTES AND DESCRIPTIONS, I, II. *By Aug. R. Grote* and *Coleman T. Robinson*. 8vo, pp. 30. 1865-6. With five plates.

NOTES ON THE SPHINGIDÆ OF CUBA. *By Aug. R. Grote*. 8vo. 1865. With two plates.

NOTES ON THE ZYGÆNIDÆ OF CUBA. *By Aug. R. Grote*. 8vo, pp. 16.

NOTES ON THE LEPIDOPTERA OF AMERICA. By *A. R. Grote* and *Coleman T. Robinson*. New York, 1867. 8vo, pp. 35. With two plates.

In a series of papers, of which we select the titles of but a few, published by these authors in the Proceedings of the Entomological Society of Philadelphia, and the Annals of the Lyceum of Natural History of New York, are descriptions of new and interesting forms of our native moths, accompanied by admirably executed lithographic plates, wherein are figured many of the rarer species, either new or previously described.

The authors have delineated many of the forms of that beautiful and

*A Geological Reconnoisance in Nebraska. From the Bulletin of the Geological Society of France, 1864.

interesting group of moths, the Bombycidæ, which contain the silk-worms of the old and the new world.

If, while reading the account of the American Silk-worm given in this journal, the reader wishes to become acquainted with its numerous allies, he cannot do better than consult the well-executed plates accompanying the papers under review. In several articles, such as those on the Sphinges and Zygænidæ, or Day-flying moths, of the Island of Cuba, prepared by the first-named author, and also accompanied by lithographic plates, many facts are adduced to show how close is the connection between the tropical insect fauna of Cuba, and the more temperate fauna of the United States. Without bringing out such interesting results as these, isolated descriptions of species are certainly dry reading and of little immediate profit to science.

THE TAXIDERMIST'S MANUAL. Third Edition. By *S. H. Sylvester*. Middleboro', Mass. 16mo, pp. 29. Price $1.00.

A very brief, but so far as it goes, accurate account of the mode of stuffing birds and mammals, with a few words on the methods of preparing skeletons, preserving eggs, and mounting insects. The information given is too scanty, and wood-cuts should have been added illustrating the methods described. The price of this little book is altogether too high.

THE AMERICAN AGRICULTURIST. Orange Judd & Co., New York.

We cannot speak in too high praise of the Natural History illustrations in the above-named journal. Every number issued contains numerous illustrations of animals and plants, drawn with fidelity, and engraved with the utmost skill. The generous manner in which this branch of science is treated, renders the journal alike valuable to the lover of nature, and to the agriculturist.

AMERICAN POMOLOGY. APPLES. By *Dr. John A. Warder*. 29 Illustrations. New York, Orange Judd & Co., 41 Park Row. 12mo, 1867.

A carefully prepared and well-printed volume, which must prove of great value to all fruit-growers. While the book is intended for readers in all parts of the country, it is especially adapted to the wants of pomologists in the Western States.

A very useful and rather new feature in this compact manual is the large number of pages (fifty-five) devoted to the insects injurious to the apple, of which over eighty species are noticed, with short descriptions, notes regarding their habits, and remedies against their attacks, which contain many practical suggestions.

The chapters on the History of the Apple, Propagation, Dwarfing, and Diseases, must interest all scientific horticulturists.

NATURAL HISTORY MISCELLANY.

BOTANY.

TENACITY OF LIFE AMONGST THE HIGHER PLANTS.—Specimens of *Lewisia rediviva*, a Portulacaceous plant, large-flowered and fleshy, growing in British Columbia, Oregon, and California, will grow, although they have been dried and in the herbarium for two or three years; and indeed the samples are often troublesome from sprouting whilst between the papers. One species, collected by Dr. Lyall, of the British Navy, was "immersed in boiling water" to stop this growing propensity, before submitting to the drying process, and yet more than a year and a half afterwards it showed symptoms of vitality, and in May, 1863, it produced its beautiful flowers in the Royal Gardens at Kew.—*Quarterly Journal of Science.*

REMAINS OF PLANTS AND ANIMALS IN A BRICK TAKEN FROM THE PYRAMIDS OF EGYPT.—Professor Unger has communicated to the Imperial Academy of Sciences, at Vienna, a paper on the vegetable and animal remains and relics of manufacturing art, contained in a brick taken from one of the Egyptian pyramids. He examined a brick from the pyramids of Dashour, which dates back from between 3,400 and 3,300, B. C., and found imbedded in the Nile mud or slime of which it is composed, animal and vegetable remains so perfectly preserved that he had no difficulty whatever in identifying them. Besides two sorts of grain he found the following familiar plants, *Pisum arvense*, *Linum usitatissimum*, *Raphanus raphanistrum*, *Chrysanthemum segetum*, *Euphorbia helioscopia*, *Chenopodium murale*, *Bupleurum aristatum*, and *Vicia sativa*. The brick contained chopped straw, thus confirming the account of the brick-making given in Exodus. The manufacturing relics consisted of fragments of burnt tile, pottery, and a small piece of twine spun from flax and sheep's wool, significant of the advance which civilization had made more than 5,000 years ago. Prof. Unger thinks that by a careful examination of a large number of bricks, much light may be thrown on the civilization of ancient Egypt. The bricks also contained abundant remains of fresh-water shells, insects, fishes, etc.—*Quarterly Journal of Science, London.*

ZOÖLOGY.

FISH CULTURE.—In the International Exposition of the Produce and Implements of Fisheries, at Bergen, were collections of young

fish, illustrating the development of the Cod, presented by M. O. Sars; of the Herring, by M. A. Boeck; and of the Trout, by C. Vogt. A series of designs were also exhibited representing the history of their development, from the vesicular state (l' état vésiculaire) in the egg, up to the moment of exclusion, and the different aspects of the fish from the time of birth to adult age. Next the drawings were placed jars containing specimens illustrating the different stages of growth. Several bottles, containing specimens illustrating the process of the artificial fecundation of the Cod, discovered by M. O. Sars, comprised:

1. Eggs of the Cod artificially fecundated, three or four hours after the operation, and showing the beginning of the divisions of the germinative disk (*disque*); 2. Eggs artificially fecundated, eleven or twelve hours after the operation, and showing the division of the germinative disk; 3. Eggs artificially fecundated, after two or three days, showing a greater division of the disk; 4. Eggs after four days of incubation, showing the perfect division of the disk; 5. Eggs eight days after artificial fecundation, showing the embryo already well formed; 6. Eggs sixteen days after artificial fecundation, showing the young fish (*alevin*) perfectly developed, and after the rupture of its envelopes; 7. Young Cod born the seventeenth day after artificial fecundation. — *Bulletin de la Societe d' Acclimatation.*

Biscuit made of Fish. — Professor Rosing, of Aas, France, has invented a biscuit of flour made of fish (*farine de poisson*), prepared like the sea biscuit. It forms a very nutritious and compact article of food, being four times as rich in albuminoid substances as beef, four and a half times as much as fresh codfish, and sixteen times as much as fresh milk. Besides, it has the advantage of being very rich in phosphates. — *Bulletin de la Société impériale Zoologique d' Acclimatation.*

The Pelican in Cayuga County, N. Y. — Some time during the spring of 1864, near a marsh on Cayuga Lake, two large birds were seen for several weeks, but one of them left a few days before the other was killed. None of the hunters had ever seen anything of the kind about here before. It proved to be a specimen of the white or rough-billed Pelican (*Pelicanus erythrorhynchus* Gmelin), in good condition, and its wings measured fully eight feet from tip to tip.

Prof. S. F. Baird, of the Smithsonian Institute, Washington, D. C., in speaking of this bird says: —

The male has on the upper mandible [upper part of the bill] a thin, elevated, bony process, about one inch high, and extended towards the end for three or four inches. The female differs in not having the bony projection on the upper mandible. It lives throughout the United States; rare on the coast of the Middle and Northern States; found as far north as the 61st parallel. This species breeds in the fur countries, generally selecting inaccessible places in the neighborhood of waterfalls. They also inhabit throughout the Rocky Mountains and in California. In winter they are very abundant on our Southern coast, from Texas to Florida. They remain inactive on sand-bars most of the day, procuring their food about sunrise, and again just before sunset. They swim buoyantly, and while feeding are very active in their movements; on such occasions they do not dive, but

secure their food by thrusting the head under water, but not keeping it below the surface for any length of time. The peculiar bony process on the ridge of the upper mandible appears to be used for the purpose of defence, when combating with their rivals; in some old individuals it is much abraded and worn, apparently caused by many and severe contests.

Audubon thus speaks of its habits:—

Ranged along the margins of the sand-bar, in broken array, stand a hundred heavy-bodied Pelicans, pluming themselves. The gorged Pelicans patiently wait the return of hunger. Should one chance to gape, all, as if by sympathy, in succession open long and broad mandibles, yawning lazily and ludicrously.

I one afternoon observed a number of White Pelicans swimming against the wind and current, with their wings partially extended, their neck stretched out, the upper mandible alone appearing above the surface, while the lower must have been used as a scoop-net, as I saw it raised from time to time, and brought to meet the upper, when the whole bill immediately fell to a perpendicular position, the water was allowed to run out, and the bill being again raised upwards, the fish was swallowed. After thus swimming for about a hundred yards in an extended line, and parallel to each other, they would rise on the wing, wheel about, and re-alight at the place where their fishing commenced, when they would repeat the same actions. The number of small fishes destroyed by a single bird is quite extraordinary. On opening one we found in its stomach several hundreds of fishes, of the size of what are usually called minnows. Its flesh is rank, fishy, and nauseous. The female is rather smaller than the male, and, in as far as I am warranted by the examination of several individuals in stating, is destitute of the horny crest of the upper mandible.

Judging from the bony process on the bill, which was about one inch high and two and a half inches long, I concluded, from the description given above, that this bird was a male; but upon dissection, I was much surprised to find the specimen a female.

The œsophagus contained two flat-fish (Bream or Pumpkin-seed, *Pomotis vulgaris*) in quite a perfect condition, one of which was six and the other eight inches in length. There were also the remains of two bull-heads, which must have been eight or ten inches in length. I found no small fish. Mr. Cave, who shot the bird, saw her fishing, as described by Audubon.—W. J. Beal.

Curious Mode of Gestation in Fish.—Dr. W. Turner, of Edinburgh, described the very curious method of gestation in a new fish, belonging to the genus *Arius*, which he had received from Ceylon. The female fish deposits her eggs, which are then taken into the mouth of the male, who swims about with them until they hatch. Dr. Turner's correspondent had been very careful to avoid any mistake or imposition in the matter. The fish lived in stagnant pools in marshy ground, where they were caught in large numbers by the natives. Dr. Günther, of the British Museum, said it was very remarkable that in South America there was a fish almost exactly like that which Dr. Turner had described; and Agassiz had lately described several others from the Amazon, possessing this curious method of gestation; none, however, had been observed in Africa.—*Quarterly Journal of Science, London.*

HABITS OF THE BITTERN.—I notice some statements respecting the breeding habits of the Bittern (*Botaurus lentiginosus*) in the lately published work of Mr. Samuels, on the Ornithology and Oölogy of New England, which are entirely at variance with my experience. He says that these birds build in bushes or low trees or tufts of grass; that the nest is of twigs, grass, and a few leaves; and that they breed in communities, a dozen or more nests being often found in the space of a few rods.

The few eggs that I have found have all been on the ground—the bare ground—among thick tufts of lambkill, on the "Fowl Meadows," which skirt the upper part of the river Neponset; nor have I been able to find more than one nest on ten acres, though I have searched most carefully. I make these remarks because I think no part of the bird's history ought to go unnoticed; and because I am convinced that he, who should expect to find a community of stick-built bittern's nests on bushes or trees in this vicinity, would be disappointed.

South Canton, Mass. W. E. ENDICOTT.

GEOLOGY.

THE MIOCENE TERTIARY FLORA OF NORTH GREENLAND.—Different voyagers have, from time to time, brought from Greenland, and lodged in various museums in Britain and Ireland, rich collections of fossil plants, all of which have been submitted to Professor O. Heer, a Swiss Naturalist. They were all found 1,080 feet above the sea, on a steep hill, at Atanekerdluk, opposite the Isle of Disco, in lat. 70° N. A total of sixty-six species have been recognized, and from them and their associated facts, the author infers that they must have grown where they were found; that they belong to a Miocene flora rich in species, at least some of which extended to still higher latitudes; that in the Miocene epoch the climate of North Greenland was warmer than it is at present by fully 16° C., or 28′ 8° F.; and he thinks that "we could not by any rearrangement of land and water produce for the northern hemisphere a climate which would explain the phenomena in a satisfactory manner." "We must admit," he adds, "that we are face to face with a problem whose solution in all probability must be attempted, and we doubt not completed by the astronomer."—*Quarterly Journal of Science, London.*

MICROSCOPY.

PHOSPHORESCENT ENTOMOSTRACA.—Minute Crustaceans, belonging to this order and allied to the genus Cypridina, were discovered in

the Pacific Ocean by Prof. J. D. Dana, while in the United States Exploring Expedition. Others have been described and figured by Major Owen, in the Microscopical Journal for 1866:—

When these were taken, the sea was alive with them. When swallowed by, or entangled with other creatures, they in their turn appear to be also luminous. They also give luminosity to the water itself as it flows over them. When they are at rest, they gradually cease to give out light; but as soon as they are disturbed or in motion, or the vessel containing them is shaken, they again become bright, even after many hours' confinement, . . . I have seen the ship's deck running with liquid fire when the net containing this species had been taken on board.

CORRESPONDENCE.

L. Q., Pennsylvania, asks for information regarding the preparation of snail's tongues for microscopical objects. They are generally mounted in Canada balsam, using a thin piece of glass as a cover to the preparation.

To dissect the membrane from the mouth, one must use needles for the very small snails, and fine knives for the larger species. One can cut with certainty on such snails as *Helix albolabris*, by slitting the œsophagus open from above, care being taken not to cut the jaw, which can be plainly seen with the naked eye. The incision is made between the larger tentacles. The membrane bearing the minute teeth is quite tough, and can be picked away with needles. For the minute snails the readiest way is to pick the head in small pieces on a glass slide. With the microscope, the portion containing the tongue can be readily detected by the tessellated appearance of that organ. All other fragments are then wiped from the slide, and the membrane can be then separated by gently pulling apart the fragment into numerous pieces, and again examining with the glass, removing as before all the bits of muscular fibre not connected with the tongue. With considerable care and patience the tongue may be removed entire. During this work the preparation must be well moistened; a drop of water is sufficient. — E. S. M.

E. L., Illinois. — The following works have been published on North American Lichens: — "A Synopsis of the Lichens of New England, the other North American States, and British America." By Edward Tuckerman, A. M., Cambridge, 1848. 1 vol. 8vo, 93 pp. "An Enumeration of North American Lichens, with a Preliminary View of the Structure and General History of these Plants, and of the Friesian System," etc. By Edward Tuckerman, A. M. Cambridge, 1845. 8vo, pp. 59.

W. H. S., Minnesota. — You will find Shirley Hibbard's Book of the Aquarium, published in London, 1856, the cheapest and best manual

we know of. For fresh-water aquaria, use glass jars and dishes. Large aquaria can be made of glass set in a soapstone frame, made water-tight by cement. Any glazier can make one. Shirley Hibbard thus describes a large tank:—

"For the adornment of a dwelling-room, or a conservatory, an oblong tank, measuring three feet by one foot six inches deep, would be very suitable. It must be borne in mind, then, that when a tank is filled, its weight is enormous, and hence it is difficult, sometimes impossible, to move it without first removing the whole or greater portion of its contents. Strength in the joints to resist pressure from within, and strength in the table or other support on which the tank is placed, is of the first importance. The bottom of such a tank is best formed of a slab of slate, and the two ends may be of slate also; the front and back of plate or very stout crown glass. The most elegant form for such a body is that of the double cube, the length of the tank being just double its width and depth, so that if it were cut into two equal parts, two cubes would be formed. The glass must be set in grooves in the slate, and bound outside with zinc or turned pillars of birch wood. The best cement is white-lead putty, or what is known as Scott's Cement, the composition of which it is not in my power to inform the reader. If a coating of shell-lac, dissolved in naphtha, and made into a paste with whiting, were laid over the white lead cement, the water would be kept from contact with the lead, and the tank would require less seasoning.

The use of slate at the ends is to enable us to affix rock-work, or carry across a rude arch; the cement used in constructing rock-work does not adhere to glass. But if rock-work is not thought desirable, the slate ends may be dispensed with, and the vessel may be composed wholly of glass, except the bottom, which may be of slate or wood. I have seen some handsome tanks composed wholly of wood and glass; it is only necessary to choose well-seasoned material, and unite the joints very perfectly.

L. Q., Pennsylvania. — We can scarcely tell from your drawing what the object can be. It is probably a Polyzoön, and possibly a species of *Lophopus*, mentioned in the June number of the NATURALIST, and if so, is very rare, and specimens would be very desirable.

NATURAL HISTORY CALENDAR.

THE INSECTS OF AUGUST. — During this month great multitudes of bugs (*Hemiptera*) are found in our fields and gardens; and to this group of insects the present chapter shall be devoted. They are nearly all injurious to crops, as they live on the sap of plants, stinging them with their long suckers. Their continued attacks cause the leaves to wither and blight.

The grain Aphis, at certain years, desolates our wheat-fields. We have seen the heads black with these terrible pests. They pierce the grain, extract the sap, causing it to shrink and lose the greater part of its bulk. It is a most insidious and difficult foe to overcome.

The various leaf-hoppers, *Tettigonia* and *Ceresa*, abound on the leaves of plants, sadly blighting them; and the *Tettigonias* frequent

damp, wet, swampy places. A very abundant species on grass produces what is called "frog's spittle." It can easily be traced through all its changes by frequently examining the mass of froth which surrounds it. *Tettigonia vitis* blights the leaf of the grape-vine. It is a tenth of an inch long, and is straw-yellow, striped with red. *Tettigonia rosæ*, a still smaller species, infests the rose, often to an alarming extent.

Fig. 1.

The *Notonecta*, or water boatman, is much like a *Tettigonia*, but its wings are transparent on the outer half, and its legs are fringed with long hairs, being formed for swimming. They row over the surface in pursuit of insects. *Notonecta undulata* of Say (Fig. 1, from Sanborn) is a common form in New England.

Another insect-hunter is the singular *Ranatra fusca* (Fig. 2, from Sanborn). It is light brown in color, with a long respiratory tube which it raises above the surface of the water when it wishes to breathe. This species connects the Water-boatman with the Water-skaters, or Gerris, a familiar insect, of which *Gerris paludum* (Fig. 3) is commonly seen running over the surface of streams and pools.

Fig. 2.

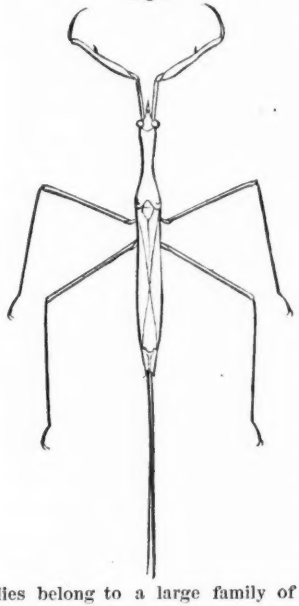


Fig. 3.

Fig. 4.

Reduvius and its allies belong to a large family of very useful insects, as they prey largely on caterpillars and noxious insects. Such is *Pirates picipes* (Fig. 4), a common species. It is an ally of *Reduvius personatus*, a

valued friend to man, as in Europe it destroys the bed-bug. Its specific name is derived from its habit while immature, of concealing itself in a case of dust, the better to approach its prey.

Another friend of the agriculturist is the *Phymata erosa* (Fig. 5). Mr. F. G. Sanborn states that "these insects have been taken in great numbers upon the linden trees in the city of Boston, and were seen in the act of devouring the Aphides, which have infested the shade-trees of that city for several years past. They are described by a gentleman who watched their operations with great interest, as 'stealing up to a louse, coolly seizing and tucking it under the arm, then inserting the beak and sucking it dry.' They are supposed to feed also on other vegetable eating insects as well as the plant louse."

Fig. 5.

Phytocoris lineolaris swarms in our gardens during this month. It is described and figured in Harris's Treatise on Insects. Closely allied, though generally wingless, is that enemy of our peace the bed-bug. It has a small, somewhat triangular head, orbicular thorax, and large, round, flattened abdomen. It is generally wingless, having only two small wing-pads instead. The eggs are oval, white; the young escape by pushing off a lid at one end of the shell. They are white, transparent, differing from the perfect insect, in having a broad, triangular head, and short thick antennæ. Indeed, this is the general form of lice (*Pediculus vestimenti*, and *P. capitis*), to which the larva of Cimex has the closest affinity. Some Cimices are parasites, infesting pigeons, swallows, etc., in this way also showing their near location to lice. Besides the *Reduvius*, the cockroach is the natural enemy of the bed-bug, and destroys large numbers. Houses have been cleared of them after being thoroughly fumigated with brimstone.

Closely allied to the bed-bug are the lice (*Pediculus*). These degraded, wingless forms of Hemiptera, still preserve the mouth parts in the form of a sucker, but it is fleshy and retractile. The triangular head has two simple eyes. The body is rather long, the abdomen oval. They are generally white, and of minute size. The metamorphosis is very incomplete,—that is, there are but slight differences between the larva and the imago. The species of *Pediculus* are blood-suckers, and parasitic upon man and some of the mammalia; different species being found upon different regions of the body. Different varieties are found living upon the bodies of different races of men.

An allied group, the *Mallophaga*, bird-lice, live on the hair of mammalia and feathers of birds. In this group there are distinct jaws. Nearly every bird and mammal has its parasite, so that the number of species is actually very large.

During this month the ravages of grasshoppers are, in the West, very wide-spread. We have just received from Major F. Hawn, of Leavenworth, Kansas, a most interesting account of the Red-legged Locust (*Caloptenus femur-rubrum*). "They commence depositing their eggs the latter part of August, which are fusiform, slightly gibbous, and of a buff-color. They are placed about three-fourths of an inch beneath the surface, in a compact mass around a vertical axis pointing obliquely up and outward, and are partially cemented together, the whole presenting a cylindrical structure, not unlike a small cartridge. They commence hatching in March, but it requires a range of temperature above 60° F. to bring them to maturity, and under such conditions they become fledged in thirty-three days, and in from three to five days after, they enter upon their migratory flight.

"Their instincts are very strong. When food becomes scarce at one point, a portion of them migrate to new localities, and this movement takes place simultaneously over large areas. In their progress they stop at no obstacle they can surmount. In these excursions they often meet with other trains from an opposite direction, when both join in one.

"The insects are voracious, but discriminating in their choice of food, yet I know of no plant they reject if pressed by hunger; not even the foliage of shrubs and trees, including pine and cedar."—A. S. P.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Lyceum of Natural History. *New York, April* 22, 1867.—Prof. Newberry read a paper on the "Ancient Vegetation of North America." In this paper the Professor briefly reviewed the records with which geology has furnished us of the changes that have taken place in the vegetation of this continent, from the earliest palæozoic ages to the present time. Of this sketch the most important facts cited were as follows:—

First,—Vegetables only have the power to assimilate inorganic substances in nature, the animal kingdom being wholly dependent on the vegetable for its substance, and could not exist without it. Plants must therefore have preceded animals upon the globe, and spontaneous generation, if it were possible, should result in the production of plants first, of animals only from them. Remains of plants occur in the oldest rocks, but only of the lowest types, seaweeds.

Second,—The first land plants appear in the Upper Devonian rocks,

conifers, ferns, lycopods, etc., the advance guard of the carboniferous flora, and having the same general character. From the variety and comparatively high organization of these plants we must infer either the somewhat sudden creation of an elaborate flora, or a great hiatus in geological history, in which its origin and development are lost.

Third, — The carboniferous flora of America is essentially the same as that of the coal-measures of the old world. Of six hundred species recognized here, at least one-third are considered identical with European forms, while the genera are nearly all the same.

The carboniferous period was one of depression in this country; the western part of the continent being all beneath the ocean, though extensive land-surfaces had existed there before. A belt of country north of the St. Lawrence was then — as it has constantly been since the beginning of the palæozoic ages — out of water, as was most of New York, and part of New England. The coal-plants grew in marshes on the western margin of the land at the sea level; a gradual submergence producing a succession of vegetable deposits, one above another. The climate was moist, uniform, and warm, but not hot, as vegetable matter would, in that case, have decayed and not bituminized. The atmosphere was also more highly carbonated than now.

Dr. Newberry exhibited drawings of some of the most characteristic plants and fruits of the coal period, with many not yet described. He said, also, that from the similarity of the flora of the coal-measures in different countries we must conclude that all the vegetation of the world at this period was of the character indicated by these specimens, and that more highly-organized plants had not yet been called into existence.

Fifth, — The Permian flora was not represented in any collection made on this continent, but from the plants obtained from the Permian rocks abroad, it was evident that the flora of that period was, like the fauna, but a continuation of that of the carboniferous.

Sixth, — In passing the interval which separates the mesozoic from the palæozoic ages we entered a new world, in which all the aspects of nature were quite unlike those of the preceding periods. New mollusks and new fishes swim in the seas; reptiles were the monarchs of animated nature, — swimming, walking, flying, carnivorous and herbivorous, in size ranging from the mouse to the whale, they filled the places now occupied by reptiles, birds, and mammals. The vegetation of the triassic and jurassic periods was as peculiar as the fauna, and constituted a distinct chapter in the botanical history of the world. The most conspicuous plants of this flora were the cycads, — now represented, by the *Lagopalene*, etc., — which had no existence before,

and has since formed an insignificant portion of the vegetation of the earth's surface. Drawings were exhibited of cycads, conifers, and ferns from the mesozoic rocks of Europe, China, North Carolina, New Mexico, and Sonora, showing the similarity of the flora of different countries in the triassic and jurassic periods.

Seventh, — With the commencement of the cretaceous period the flora of the world was again revolutionized, and the highest order of plants — the angiosperms — make their first appearance; in Europe, mingled with the remains of the preceding flora, in America in overwhelming numbers. In the lower cretaceous rocks of this continent we have already discovered nearly one hundred species of broad-leaved dicotyledonous plants, including several genera now living in our forests, such as willows, poplars, tulip-tree, sassafras, magnolia, sycamore, beech, etc. From these facts it appears that the vegetation of North America had not greatly changed from the beginning of the chalk period to the present time, showing great permanence in the physical condition of the country.

Eighth, — Of our Eocene flora we have obtained few specimens. The flora of Europe, during that period, was decidedly tropical in character.

Ninth, — The Miocene flora of America has been very fully illustrated by the collections made in Mississippi, on the Upper Missouri, near the mouth of Frazer River, on the McKenzie, and on Disco Island, off the west coast of Greenland. Over one hundred species have been obtained from these localities, some of which were common to them all. Several of these species are now living in our country, and quite a number have been found in the Miocene tertiary of Europe.

The most important part of Dr. Newberry's paper was that which included a comparison of the Miocene flora of America with that of Europe of the same age, and both with living floras of the two continents. The conclusions derived from their comparisons are briefly as follows: —

First, — The living flora of North America is the legitimate progeny of the cretaceous and tertiary floras of the same continent; most of the genera of the earlier floras being continued into the present one, and many species of the Miocene being apparently identical with some now living.

Second, — In the Miocene epoch, the European and American continents were connected at the north, and over this bridge the American flora passed to Europe, leaving its records on Disco Island, Iceland, the Island of Mull, etc. This flora is that of a temperate climate, and, following a depression of temperature, it replaced the Eocene tropical

flora of Europe, and for a time covered the surface of that country with American plants, magnolia, liquid amber, sassafras, liriodendron, etc., etc.

Third, — That at a subsequent period, the connection between the two continents was severed by a depression of North-west Europe, and the American flora was nearly exterminated by the present flora of Europe, which is mostly of Asiatic origin.

Fourth, — The present flora of China and Japan, as Professor Gray has shown, has many American elements, probably the living representatives of the Miocene flora. One genus, Glyptostrobus, a conspicuous feature in the Miocene flora in America and Europe, is now living only there; and several American Miocene and living species (*Onoclea sensibilis*, etc.) now form part of the flora of Japan. These plants are probably the descendants of American Miocene emigrants.

Dr. Newberry also exhibited drawings of a number of fossil fishes and reptiles from the coal-measures of Ohio. The fishes represented the genera Diplodus, Pleuracanthus, Megalichthys, Palæoniscus, Cœlacanthus, Rhizodus, Eurylepis, etc., of which the species were all new, and the last a new genus. Of the reptilian remains, the most perfect had been described by Professor Wyman, under the name of Ranaceps Lyellii; the others included several much larger and yet undescribed forms. Among these reptilian bones were two elongated vertebral columns, which, from their singular structure, in the absence of the head and extremities, had greatly puzzled our comparative anatomists. Dr. Newberry announced, however, that this mystery was solved by a recent discovery in the Irish coal-measures of complete individuals of what seemed, from the descriptions given, to be identical species. These had been described by Professor Huxley, under the name of Ophiderpton, or snake-lizard, a very appropriate name, as these reptiles had an elongated snake like form, with insignificant limbs, something similar to our living Cæcilia, but being doubtless an amphibian. The associated reptiles were also probably amphibious, aquatic in habit, and to be compared with Menopoma and Menobranchus.

The president, Professor C. A. Joy, read a report upon recent chemical discoveries and applications.

Mr. Bailey exhibited a fossil frog from the brown coal of the Rhine. It resembles closely some of the living species, and the question was discussed whether live toads were ever actually found imbedded in the rock. The president stated that there was no authentic instance of a live toad having been found in the solid rock. All such stories were myths, and no scientific man gave any credence to them.

California Academy of Natural Sciences. *San Francisco, May 6*, 1867. — The Committee on Field Excursions reported in reference to the recent excursion to the Twelve Mile Farm, on the San José Road. Mr. Lorquin mentioned the species of birds seen or collected. Mr. Yale presented a fragment of rock from the fossiliferous outcrop near the above place, — a blue sandstone, which is undergoing decomposition, containing many species of shells of post-pliocene forms, many of them the same as living species, according to Mr. Stearns. Prof. Whitney remarked upon the singularly isolated character of this outcrop, which is also quite narrow and limited. He had tried to find traces of it many miles beyond, but did not succeed. The fact was one of many evidences going to show the extensive denudation that had occurred in this part of the State. Dr. Behr presented a chrysalis of a peculiar moth from Mazatlan, the female of which does not undergo a metamorphosis or change from the grub state, while the mate is the same as other moths.

Mr. Stearns submitted, on behalf of Mr. J. Rowell, a description of a new species of *Pisidium*, a genus of fresh-water bivalves, found at Angel Island on the occasion of the late excursion, to which is given the name of *P. Angelica*. He also read a paper upon Parhelia, and a recent display of these phenomena witnessed by him in this city. Some remarks followed upon sun and moon halos, during which Dr. Gibbons combated the popular notion that halos about the moon were infallible signs of rain. His observations proved that in some seasons these signs invariably failed in California, and at the East no rule, he thought, could be established on the subject.

Mr. Goodyear read a paper by Prof. Silliman, noticing new localities of diamonds. One from French Corral weighed 5.114 grains, equal to 1⅓ carats, symmetrical in form, and slightly yellow in color from being subjected to a fire test. It was found in the gravel washings. The second specimen is from Forest Hill, El Dorado [Placer?] county; weight 5.673 grains, equal to nearly 1½ carats; color good, but less perfect and symmetrical than the first. The third specimen is from Fiddletown, Amador county. It is smaller and less perfect than either of the others. Since 1855 five diamonds are known to have been found at Fiddletown, none weighing much over a carat. All were found in a gray, cemented gravel, underlying a stratum of lava or compact volcanic ashes. The fourth specimen is from Cherokee Flat, Butte county, which has acquired some reputation as a diamond locality. It has been cut and set in a ring.

Prof. Whitney remarked that there are fifteen localities in California at which diamonds have been found in the course of washings for

gold. In reply to a question if there was not some familiar test by which miners might prove them, he answered that the easiest way was to try their hardness on other gems, but miners have not always these convenient to do so. A knowledge of the crystalline form, twenty-four sided and the faces curved, was the surest test. He said that the popular notion that a diamond could be hammered on an anvil without breaking was a mistake, resulting from confounding hardness and toughness. He remarked further that it would not pay in California to wash the gravel beds solely for diamonds. Diamond washings do not pay in any country except with slave or convict labor.

Prof. Whitney read a paper on the geological position of coal. The object of this paper was to show how completely the result of modern geological explorations and discoveries had done away with the old idea that valuable beds of coal are confined to any one member of the series of geological formations. The recent investigations of geologists in India, China, Australia, New Zealand, South America, and on the Pacific Coast of North America were noticed and commented on. It was shown that while the important coal-fields of Eastern Europe and Eastern United States are of Palæozoic age, those of India, China, and Australia, on the other hand, belong to the Mesozoic series chiefly, although there are important deposits even as recent as the Cainozoic or Tertiary. Prof. Whitney remarked on the distribution of the principal coal-fields of the world into two great groups, on opposite sides of the globe; one of them is of Palæozoic and the other of Mesozoic age. He referred particularly to the coal of the Pacific coast of North America, and gave a brief account of its geographical distribution and geological age, noticing particularly the fact that most of the valuable fields of that region belong to the Cretaceous series, a geological formation which, in other parts of the world, has been found to be one of the most barren in combustible materials. In conclusion, the importance of coal discoveries in the region between the Rocky Mountains and California to the successful operation of the Pacific Railroad was explained, and the hope expressed that the geological expedition recently set on foot by the General Government—at the head of which is Mr. King, late of the California Survey—might be the means of giving to the world reliable information in regard to the coal resources of that region, of which we now know so little.

Dr. Cooper stated that Mr. Bischoff, the zoölogist appointed to accompany the Government exploration of Russian America, was now on his way hither, if he had not already arrived. When on that coast before, he had found birds nearly identical with living species in Asia, a fact of much interest, since none of the same species are found on

the eastern coast of America. There is here another suggestion of the former intimate relations between western America and Asia.

Prof. Whitney submitted for publication a very valuable and original paper by Baron Richthofer, on the subject of geology, particularly with reference to the natural system of volcanic rocks. Its publication as the first volume of the Academy's Memoirs was proposed. It consists of one hundred and fifty manuscript pages.

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The Naturalist's Note-book, No. 5. May, 1867. London, small 4to.

Notes on the Vespertilionidæ of Tropical America. By H. Allen, M. D. From the Proceedings of the Academy of Natural Sciences. August, 1866. 8vo. pp. 9.

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The Taxidermist's Manual. Third Edition. By S. H. Sylvester. Middleboro', Mass. 16mo., pp. 29.

Abstract from a Verbal Discourse upon the Mounds and the Mound Builders of Ohio. By Colonel Charles Whittlesey. 8vo, pp. 5.

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An Elementary Treatise on American Grape Culture and Wine Making. By Peter B. Mead. Illustrated with nearly 200 engravings drawn from nature. New York, Harper & Brothers. 1867, 8vo. From A. Williams & Co.

Histoire des Picea qui se rencontrent dans les Limits du Canada. Par L'Abbé Ovide Brunet. Quebec, 1866. 8vo, pp. 16. With three plates.

Catalogue des Végétaux Ligneux du Canada. Par L'Abbé Ovide Brunet. Quebec, 1867. 8vo, pp. 64.